

MERRIMACK RIVER BASIN  
SUTTON, NEW HAMPSHIRE

**CASCADE BROOK DAM**

**NH 00082**

**NHWRB 231.15**

**PRELIMINARY INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM**



**LOW HAZARD DAM**

**DECEMBER 1980**

Cascade Brook Dam  
New Hampshire 00082

NHWRB 231.15

Sutton, New Hampshire

The Cascade Brook Dam is located on Cascade Brook in Sutton, New Hampshire, approximately 2.5 miles upstream of Tannery Pond. The dam can be reached from Baker Road which crosses Cascade Brook approximately 2,000 feet downstream of the dam. The dam is shown on USGS Mt. Kearsage NH Quadrangle at approximate coordinates N4323.2, W7155.1. The dam is owned by the New Hampshire Fish and Game Department, 34 Bridge Street, Concord, New Hampshire, 03301.

The dam consists of a gravity, concrete, overflow type spillway and a wasteway equipped with stoplogs. The dam is approximately 100 feet long and 11 feet high. The wasteway is 5 feet wide and 8.5 feet high with an invert elevation of 91.0 feet (NGVD). The wasteway is equipped with stoplogs to elevation 95.3 which is the elevation of the spillway crest. The spillway is 92 feet long and is divided into 5 bays by concrete buttresses which are 1 foot wide and 1 foot high. Four bays are 18 feet wide and the bay at the right end is 16 feet wide. There are holes provided along the crest of the dam for flashboard stanchions although no flashboards or stanchions were in place on November 2, 1980. The dam appears to be in good condition, however, a detailed inspection was not made.

The dam was constructed in 1954 as a waterfowl management area by the New Hampshire Fish and Game Department. The area also serves recreational purposes. The drainage area for this dam covers approximately 8.4 square miles of rolling mountainous terrain which is primarily forested. Substantial storage exists just upstream of the dam in the form of a large, swampy area.

Downstream of the dam, Cascade Brook continues with a wide channel bottom and heavily wooded overbanks. About 900 feet downstream of the dam, Cascade Brook flows through two corrugated metal pipes which are six feet and four feet in diameter and form a bridge for a light-duty road. The road is about 10 feet above the channel bottom and no housing in the area is affected by flooding.

Downstream of this bridge structure, Cascade Brook flows through another gently sloping area with heavy growth in the overbanks. The flow is attenuated in this area, prior to crossing a minor dirt road about 2,300 feet downstream of this structure. The brook then enters a large swampy area that provides a significant amount of storage.

#### Design Data

There is a design drawing available and a 1974 inspection report both of which are included in Appendix B of this report. It should be noted that the dimensions shown on the drawings for the length of the spillway do not agree with measurements taken by the inspection party which are stated above.

### Dam Failure Analysis

The peak outflow at the Cascade Brook Dam that would result from dam failure is estimated using the procedure suggested in the Corps of Engineers, New England Division's April 1978 "Rule of Thumb Guidelines for Estimating Downstream Failure Hydrographs." Failure is assumed to occur as soon as the dam abutments are overtopped. This is 11 feet above the natural streambed level. Just prior to failure, the normal outflow through the spillway would be 3,320 cfs, with a tailwater level estimated to be 4.5 feet below the headwater level. Assuming a 40 foot gap is opened in the dam, the peak failure outflow through this gap and the spillway would be 4,400 cfs.

In Cascade Brook, downstream of the dam, this outflow would result in a depth of flow of 8.0 feet, which is 1.5 feet above the 6.5 foot depth assumed to exist just prior to failure. There are no structures that will be affected by flood flow between the dam and a road crossing 900 feet downstream of the dam. The 6 foot and 4 foot pipes at this crossing are inadequate for the expected failure flow and the roadway at this point would be overtopped with possible damage to the roadway and its embankment.

The small bridge crossing downstream of the roadway might also wash out. The flow then enters a large swampy area. Here, the storage available will considerably attenuate the flood flow, and it should have no further affect on the more populated area of Wilmot Flat, located 2.7 miles downstream of the dam.

### Hazard Classification

The hazard potential of the Cascade Brook Dam is considered to fall within the LOW category. Failure of the dam would not be expected to result in loss of human life and no houses will be affected by flooding.

In particular, two minor bridge structures would probably be washed out. Since the areas serviced can be reached by other main roads, the washouts are considered to be of minor significance.

APPENDIX A  
PHOTOGRAPHS





1. Spillway From Right Abutment - Note: No Flashboards in Place





2. Spillway and Right Abutment



3. Left Abutment and Stoplog Bay





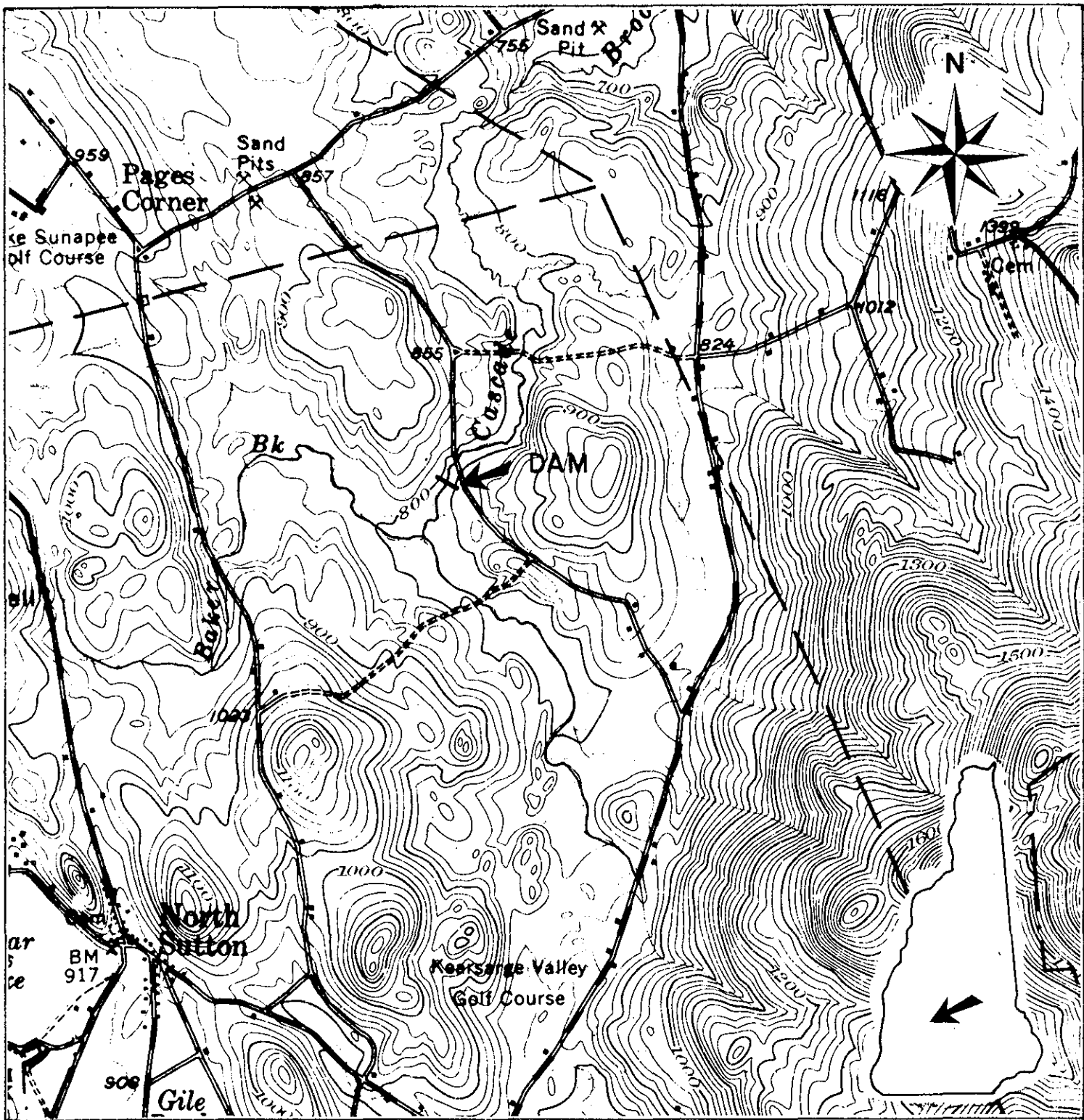
4. Stoplog Bay From Upstream - Note: Debris in Outlet



5. Reservoir Area



APPENDIX B  
ENGINEERING DATA



— SCALE —  
0 1/4 1/2 1 (MILE)  
FROM: USGS MT. KEARSARGE - N.H. QUADRANGLE MAP

GOLDBERG-ZOINO & ASSOCIATES, INC.  
GEOTECHNICAL-GEOMORPHOLOGICAL CONSULTANTS  
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

## LOCATION MAP

FILE No. 2605

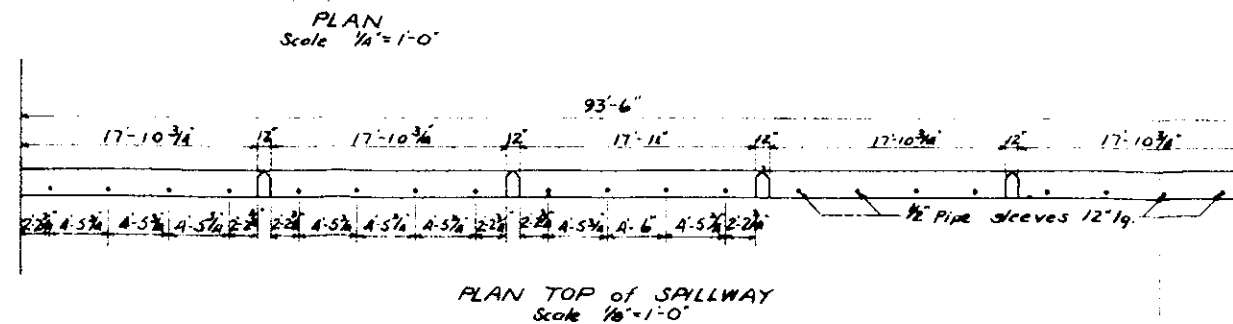
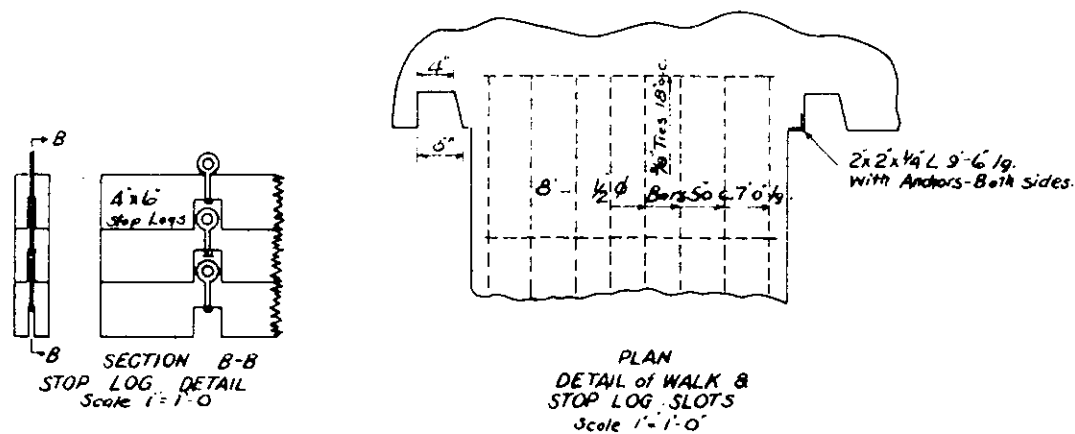
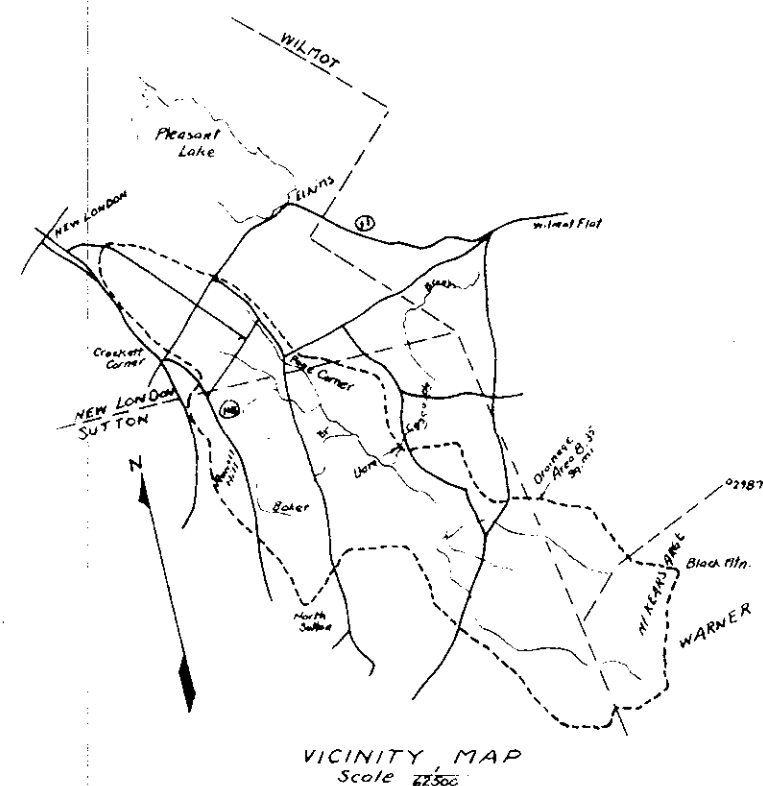
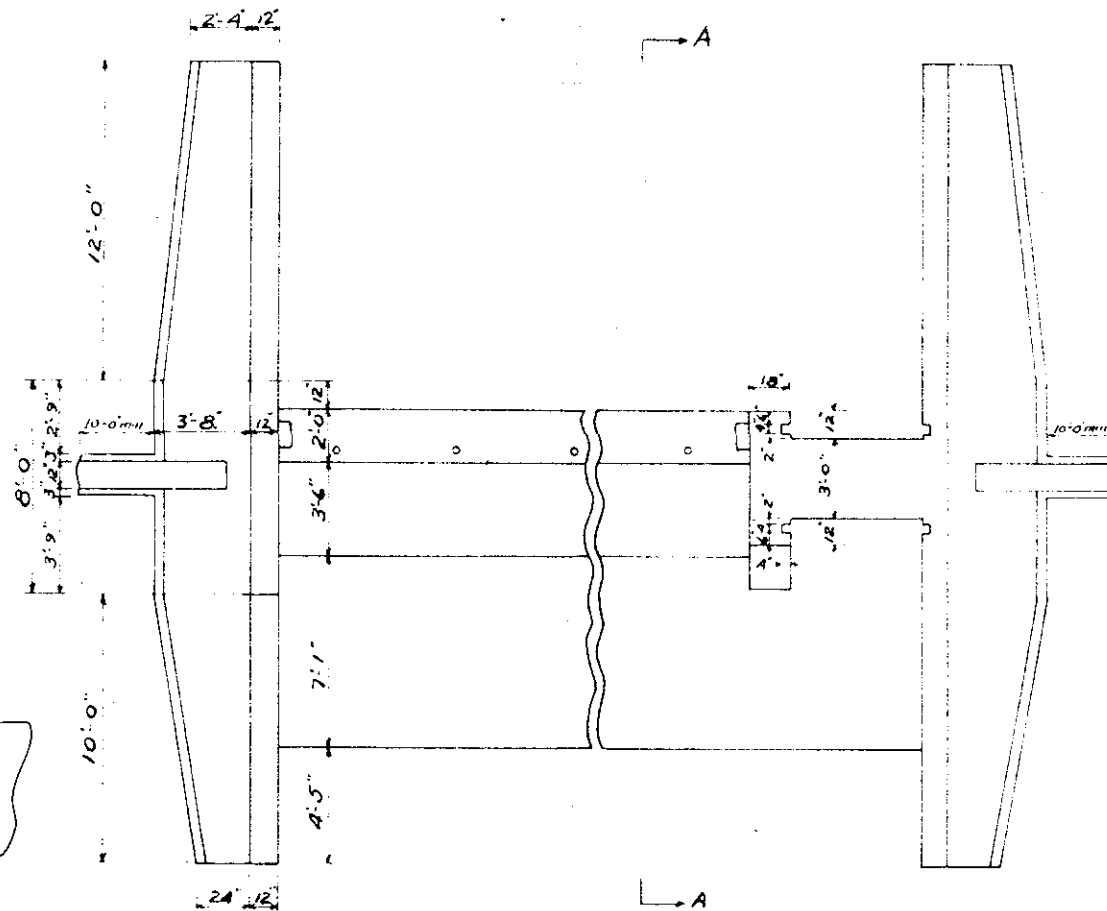
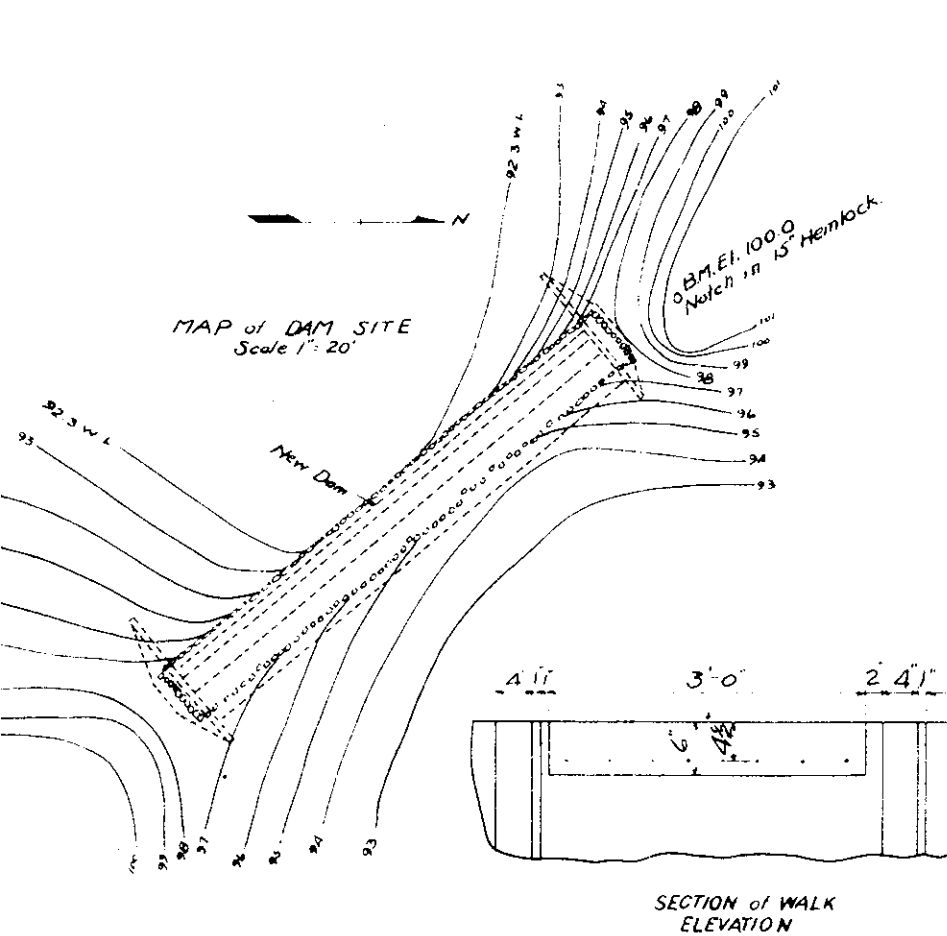
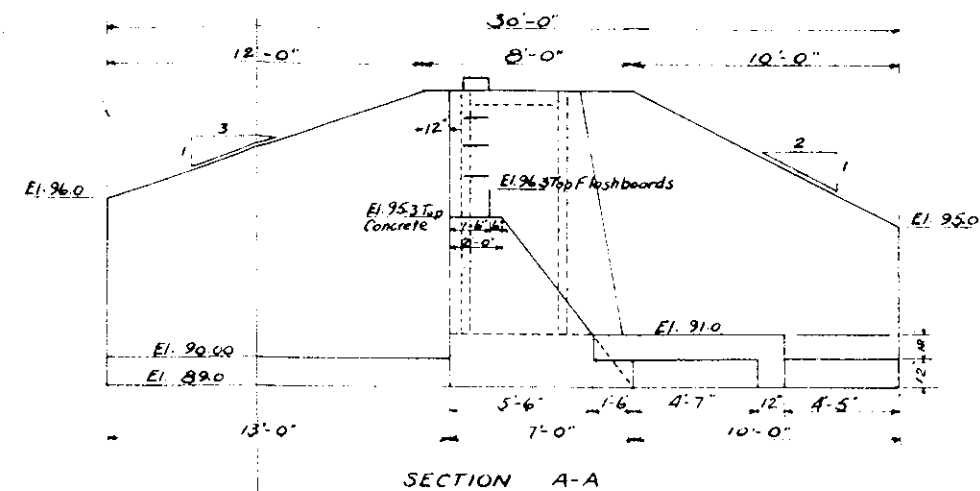
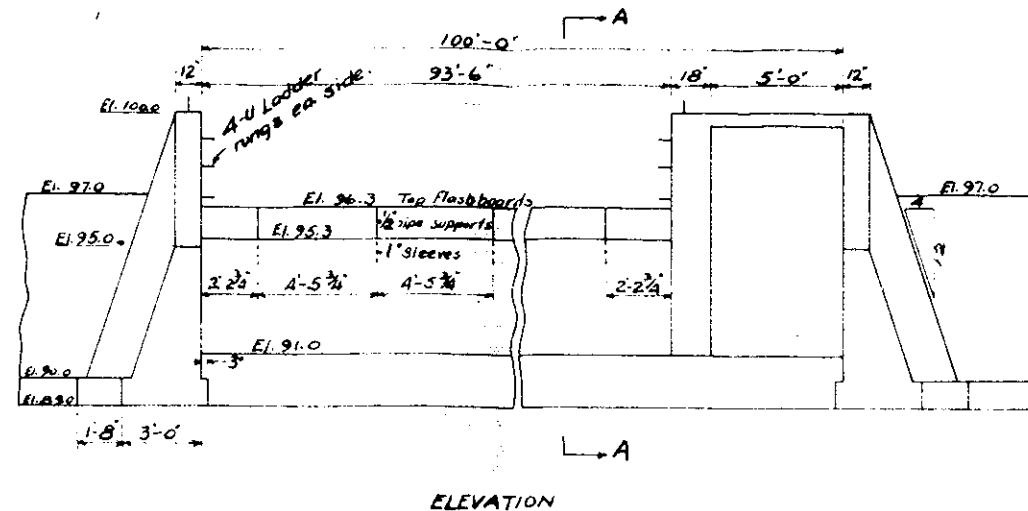
CASCADE BROOK DAM

SUTTON, NEW HAMPSHIRE

SCALE AS SHOWN

DATE

Notes:  
 Concrete, gravity sections, to be "Class C" 2000<sup>psi</sup> concrete. Reinforced concrete to be "Class A" 3000<sup>psi</sup> test.  
 Provide 4-U shaped ladder rungs 12" wide, bent from  $\frac{3}{4}$ " steel bars, at each end of spillway section for access to top of spillway.  
 Set 20-1" Galv. Stl. pipe sleeves in top of spillway Section, 6' from downstream edge, to take  $\frac{1}{2}$ " Galv. pipe flashboard supports. Flashboards designed to fail with 18" water over.  
 Foundations of Dam to go to grade indicated or to impervious material. Cut-off or core walls, to go into earth wings as far as necessary.  
 Drainage Area 8.35 sq. mi. Peak discharge 1000 c.f.s. or 2.08' over 100' spillway.  
 Bill of Materials:  
 Concrete 200 cy  
 8- $\frac{3}{4}$ " U shaped ladder rungs  
 9- $\frac{1}{2}$ " Reinforcing Stl. Bars 7'-0" lg.  
 5- $\frac{3}{4}$ "  
 150 Bdl. 1" Stop logs.  
 200 2" Flashboards  
 2-2x2x $\frac{1}{4}$ " Ls 9'-0" lg. with anchors.  
 20-1" Galv. Stl. pipe sleeves 12" lg.  
 20- $\frac{1}{2}$ " Supports 2'-0" lg.



CASCADE BROOK DAM		
SUTTON, N. H.		
Scale as shown	Date - Aug 1954	
Drawn H.D.	FISH AND GAME DEPT.	SHT. NO.
Checked	STATE OF	1
Approved	NEW HAMPSHIRE	

N. H. WATER RESOURCES BOARD  
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Sutton Dam Number: 231.15  
Inspected by: SOB Date: 23 Oct 1974  
Local name of dam or water body: \_\_\_\_\_  
Owner: F & G Address: \_\_\_\_\_  
Owner was/was not interviewed during inspection.  
Drainage Area: 8.22 sq. mi. Stream: \_\_\_\_\_  
Pond Area: \_\_\_\_\_ Acre, Storage \_\_\_\_\_ Ac-Ft. Max. Head \_\_\_\_\_ Ft.  
Foundation: Type \_\_\_\_\_, Seepage present at toe - Yes/No, \_\_\_\_\_  
Spillway: Type Overflow, Freeboard over perm. crest: \_\_\_\_\_,  
Width 93.5, Flashboard height \_\_\_\_\_,  
Max. Capacity \_\_\_\_\_ c.f.s.  
Embankment: Type \_\_\_\_\_, Cover \_\_\_\_\_ Width \_\_\_\_\_,  
Upstream slope \_\_\_\_\_ to 1; Downstream slope \_\_\_\_\_ to 1  
Abutments: Type \_\_\_\_\_, Condition: Good, Fair, Poor  
Gates or Pond Drain: Size 5' Capacity \_\_\_\_\_ Type Stoplog  
Lifting apparatus \_\_\_\_\_ Operational condition \_\_\_\_\_  
Changes since construction or last inspection: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Downstream development: \_\_\_\_\_  
This dam would/would not be a menace if it failed. Paul Area  
Suggested reinspection date: \_\_\_\_\_  
Remarks: Stoplog Sect - Filled in by beavers  
Stoplog sect OK 30 Apr 76 SOB  
\_\_\_\_\_  
\_\_\_\_\_

June 15, 1955

New Hampshire Fish and Game Department  
34 Bridge Street  
Concord, New Hampshire

Gentlemen:

At a session of the New Hampshire Water Resources Board held at its offices in Concord, New Hampshire, on June 15, 1955:

WHEREAS, the New Hampshire Fish and Game Department has filed with this Board on May 1, 1955 a petition requesting approval to construct a dam in North Sutton, New Hampshire; and

WHEREAS, the Board has considered all the evidence pertaining to said petition and finds that if constructed in accordance with the plans and specifications filed and is properly maintained, it will not be a menace to the public safety;

IT IS ORDERED, that the petition of said New Hampshire Fish and Game Department be and is hereby granted with the understanding that the work shall be performed in accordance with the plans and specifications filed and that the dam shall be maintained properly at all times.

By order of the New Hampshire Water Resources Board  
this fifteenth day of June, 1955.

Very truly yours,

Leonard R. Frost  
Water Resources Engineer

lrf:c



Form WCC. 1  
7/30/37

THE STATE OF NEW HAMPSHIRE

County of Merrimack, ss. May 1 1955

PETITION FOR APPROVAL OF THE CONSTRUCTION OR

REPAIR OF DAM AT North Sutton

**RESOURCES BOARD**  
TO THE WATER ~~CONTROL COMMISSION~~:

In compliance with the provisions of Laws of 1937, c. 133, an Act establishing  
a Water ~~Control Commission~~, **Resources Board**

We, N. H. Fish and Game Dept.

I, (Here state name of person or persons, partnership, association, corporation,  
etc.)

~~Water Control Commission~~ <sup>Resources Board</sup>  
hereby petition the ~~Water Control Commission~~ for approval to construct, to recon-  
struct, to make repairs to, a dam along, or (cross out portion not applicable)  
across Cascade Brook  
(Here state name of stream or body of water)

at a point 2 1/2 miles upstream from Tannery Pond  
(Here give location, by distance from mouth of stream, county

in Wilmot Flat  
or municipal boundary)

in the town (s) of N. Sutton

in accordance with PRELIMINARY PLANS, and SPECIFICATIONS FILED WITH THIS APPLICA-  
TION and made a part hereof.

The purpose of the proposed construction is to recreate  
(Here briefly state use to

a pond for the benefit of fish and  
which stored water is to be put)  
wild life.

The construction will consist of concrete dam and  
(Here give brief description of work con-

core walls. Spilling 6.3' high.  
templated including height of dam)

All land to be flowed <sup>is not</sup> ~~is~~ owned by applicant.

N. H. Fish & Game  
by Allen & Lewis

Address 34 Bridge St.  
Concord, N.H.

Note: This application together with plans, specifications and information and data filed in connection herewith will remain on file in the office of the Water Control Commission. ~~Resources~~ **RESOURCES BOARD.**

APPENDIX C  
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

DAM FAILURE ANALYSIS

See schematic sketch of dam on next page.

Outflow at Failure = Outflow through breach  
+ Normal outflow at failure elevation of pool.

Assume that the dam fails at the top of the abutments 4.7' above the main spillway crest and 11' above the streambed. Also assume that the 1' piers will have a negligible affect on flow at this elevation.

Normal Outflow at Failure

Main spillway section:

$$Q = CLH^{1.5}$$

$$C = 3.3 \quad L = 92.0' \quad H = 4.7'$$

$$Q = 3.3 * 92 * 4.7^{1.5} = 3100 \text{ cfs}$$

Stop log section:

$$Q = 3.3 * 5 * 4.7^{1.5} = 170 \text{ cfs}$$

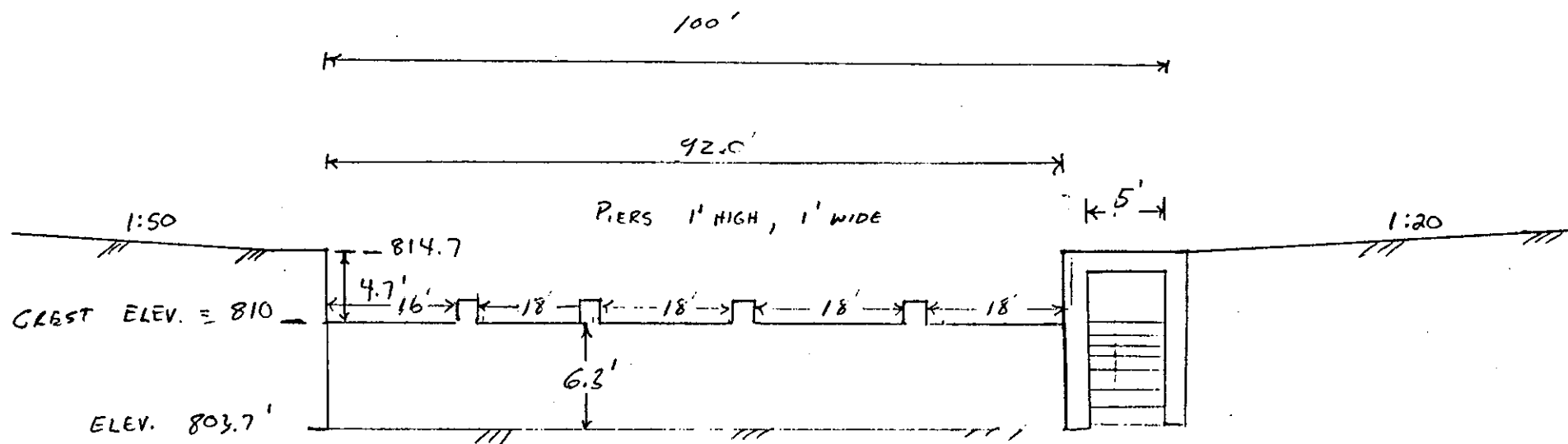
TOTAL NORMAL OUTFLOW AT FAILURE

$$= 3100 + 170 = 3270 \text{ cfs}$$

# SCHEMATIC OF CASCADE BROOK DAM

NOT TO SCALE

ELEVATIONS BASED ON A LOCAL DATUM AND U.S.GS MAP



BASED ON blue line plan sheet of Cascade Brook Dam.

BREACH OUTFLOW

$Y_0$  = depth of tailwater at failure, or  
failure elevation

$$Y_0 = 814.7 - 803.7 = 11'$$

$W_b$  = width of breach

$$\approx .4 * (\text{width of dam at } 1/2 \text{ height})$$

use dam width of 100' (include stop log section)

$$W_b = .4(100) = 40'$$

$$Q_{p1} = \frac{8}{27} * W_b * \sqrt{g} * Y_0^{1.5}$$
$$= \frac{8}{27} * 40 * \sqrt{32.2} * 11^{1.5}$$

$$Q_{p1} = \underline{\underline{2450}} \text{ CFS}$$

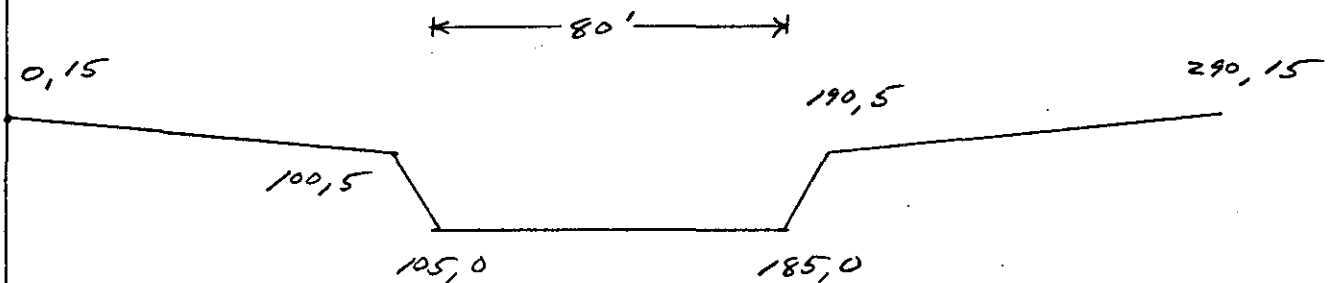
TOTAL OUTFLOW

Since the dam width for the breach outflow calculations is equal to the dam spillway section, 40% of the normal outflow is included in the breach outflow calculation. So, only 60% of the normal outflow should be used in computing the total outflow.

$$\underline{\underline{\text{TOTAL OUTFLOW}}} = .6 (\text{NORM. OUTFLOW}) + \text{BREACH OUTFLOW}$$
$$= .6 (3,270) + 2450 = \underline{\underline{4,412}} \text{ CFS}$$

DOWNSTREAM FLOODING

Downstream Cross section  
(NOT TO SCALE)



Main Channel  $n = .035$

Overbank  $n = .08$

Slope = .0015 '/'

From the rating table for this cross section, a failure flow of 4,412 cfs would create a stage of 8.0'. This is an increase of 1.2' over the normal outflow just prior to failure. (The normal outflow of 3,270 cfs corresponds to a stage of 6.8').

Approximately 900' downstream of the Cascade Brook Dam, Cascade Brook flows under a light-duty <sup>road</sup> through a 6' C.M. pipe and a 4' C.M. pipe. The 4' pipe is on the channel

===== DATA FOR THE COMBINED SYSTEM =====

DEPTH ft.	ELEV ft.	AREA ft <sup>2</sup>	WPER ft.	HYD-R ft.	AR2/3	Q cfs
0.00	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.5	40.3	81.4	0.5	25.2	41.5
1.00	1.0	81.0	82.8	1.0	79.8	131.6
1.50	1.5	122.3	84.2	1.5	156.7	258.4
2.00	2.0	164.0	85.7	1.9	252.9	416.9
2.50	2.5	206.3	87.1	2.4	366.5	604.3
3.00	3.0	249.0	88.5	2.8	496.3	818.3
3.50	3.5	292.3	89.9	3.3	641.3	1057.5
4.00	4.0	336.0	91.3	3.7	800.8	1320.5
4.50	4.5	380.3	92.7	4.1	974.2	1606.3
5.00	5.0	425.0	94.1	4.5	1160.9	1914.2
5.50	5.5	472.5	104.2	4.5	1294.5	2264.5
6.00	6.0	525.0	114.2	4.6	1451.2	2640.9
6.50	6.5	582.5	124.3	4.7	1631.3	3044.8
7.00	7.0	645.0	134.3	4.8	1835.7	3477.0
7.50	7.5	712.5	144.4	4.9	2065.1	3938.3
8.00	8.0	785.0	154.4	5.1	2320.6	4429.7
8.50	8.5	862.5	164.5	5.2	2603.2	4951.7
9.00	9.0	945.0	174.5	5.4	2913.8	5505.2
9.50	9.5	1032.5	184.6	5.6	3253.5	6090.8
10.00	10.0	1125.0	194.6	5.8	3623.3	6709.1
10.50	10.5	1222.5	204.7	6.0	4024.3	7361.0
11.00	11.0	1325.0	214.7	6.2	4457.4	8046.9
11.50	11.5	1432.5	224.8	6.4	4923.9	8767.6
12.00	12.0	1545.0	234.8	6.6	5424.6	9523.7
12.50	12.5	1662.5	244.9	6.8	5960.6	10315.8
13.00	13.0	1785.0	254.9	7.0	6532.9	11144.6
13.50	13.5	1912.5	265.0	7.2	7142.5	12010.7
14.00	14.0	2045.0	275.0	7.4	7790.4	12914.6
14.50	14.5	2182.5	285.1	7.7	8477.6	13857.0
15.00	15.0	2325.0	295.1	7.9	9205.0	14838.5



bottom and the invert of the 6 foot pipe is 2 feet above the channel bottom. The top of the road is 2 feet above the low cord on the 6 foot pipe.

These pipes are too small to allow a failure flow of 4,412 cfs. Although the overbanks for this bridge are now lined with large rip-rap stones, this bridge would probably wash out if the dam fails.

Downstream of this bridge structure, the failure flow enters an undeveloped and heavily wooded area for another 2300'. It is expected that the flow will continue to attenuate <sup>in this section</sup>, yet it would still be sufficient to wash out a dirt road bridge at the end of this reach. Downstream of this point the failure flow enters a large swamp area that provides adequate storage to attenuate the flood before it reaches the more developed area of Wilmot Flat.

HAZARD CLASSIFICATION

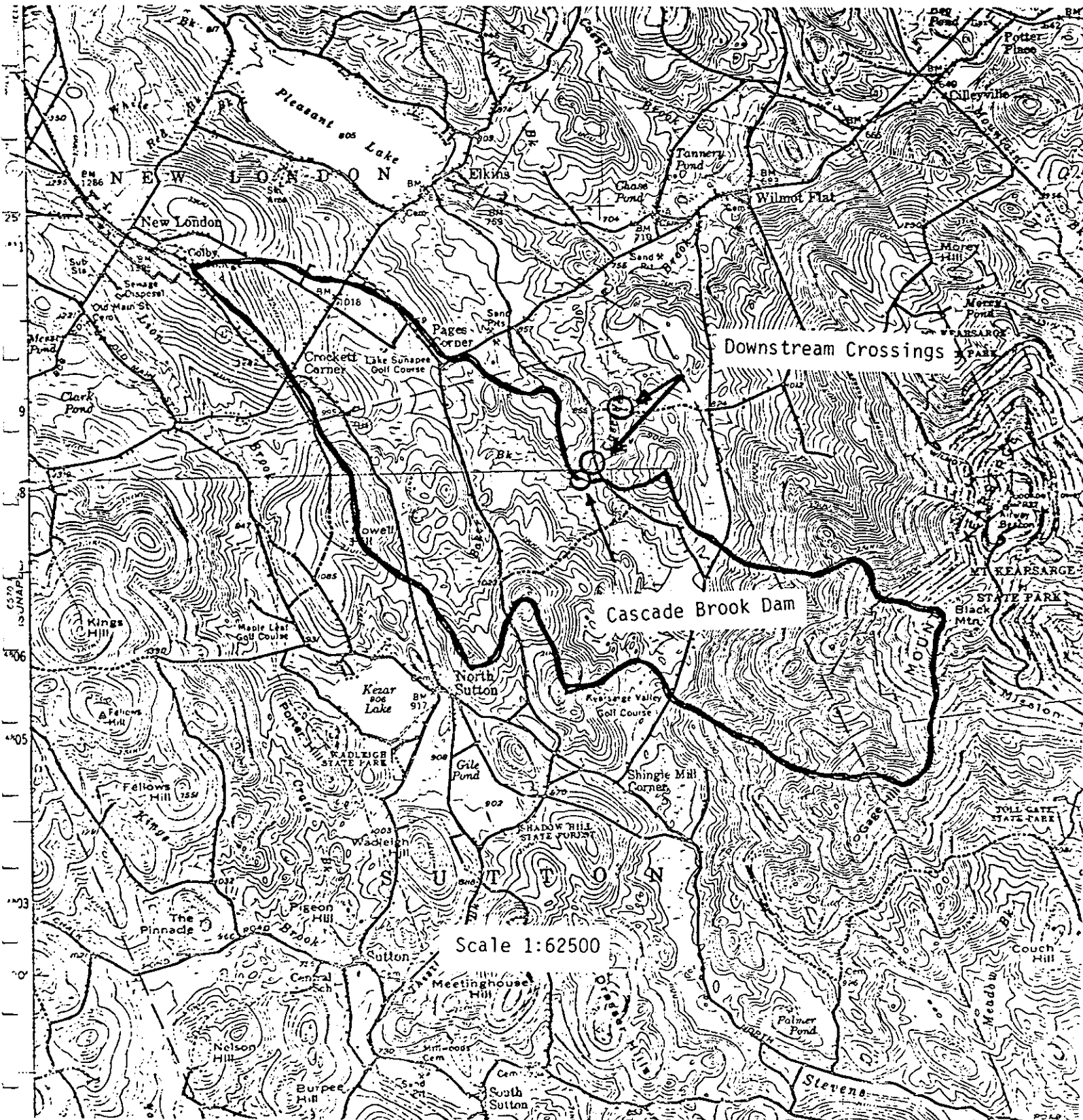
Failure of the Cascade Brook Dam would result in only a 1.5 foot rise in the stage in the section downstream. Although failure flow would wash out two minor structures, this would create only a temporary inconvenience. And since no houses are affected by downstream flooding and no loss of life is expected, this dam has been classified as low hazard.

TEST FLOOD ANALYSIS

Because the Cascade Brook Dam is classified Low Hazard, a Test Flood analysis, along with stage-discharge and stage-storage calculations at the dam, has not been performed.

# LOCATION AND DOWNSTREAM HAZARD MAP

Cascade Brook Dam  
Sutton, New Hampshire



NEDED-E

17 June 1981

New Hampshire Fish & Game Department  
34 Bridge Street  
Concord, NH 03301

Gentlemen:

Inclosed for your use is a copy of the Report on Cascade Brook Dam (NH-00082). During the field inspection and the early stages of the preparation of this report, our contractor found that this dam had a "low potential hazard" for downstream damage in the event of a failure. Based on this finding, we directed our contractor to terminate his work and summarize the work accomplished to date. The report inclosed is a copy of this summary.

If you have any questions concerning this report, we suggest you contact the New Hampshire Water Resources Board first; then if there are further questions contact Mr. Gould, Project Management Branch, Engineering Division of this office at (617) 894-2400, extension 313.

Sincerely,

Incl  
as stated

JOE B. FRYAR  
Chief, Engineering Division

CF: Mr. Gould ✓  
Eng Div Files

NEDED-E

17 June 1981

Mr. George M. McGee, Sr.  
Chairman, New Hampshire Water Resources Board  
State of New Hampshire  
Concord, New Hampshire 03301

Dear Mr. McGee:

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Sincerely,

Incl  
as stated

JOE B. FRYAR  
Chief, Engineering Division

CF: Mr. Gould ✓  
Eng Div Files